

REMARKS

Claims 1-4, 6-23 and 25-80 remain pending in the present application. Claims 37-66, 69-74 and 77-80 have been withdrawn from consideration by the Examiner. Claims 67 and 68 were rejoined for consideration by the Examiner, responsive to Applicants' traversal of the Restriction Requirement. Claims 12 and 31 were objected to by the Examiner as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form to include the limitations of the base claim and any intervening claims. New claims 81 and 82 have been presented by Applicant for consideration by the Examiner and are believed to be directed to patentable subject matter. Applicant appreciates the Examiner's consideration of the Application.

The § 102 Rejections

The Examiner rejected Claims 1-4, 9-11, 15, 20-23, 28-30, 32, 33, 67 and 68 under 35 USC 102(e) as being anticipated by U.S. Patent Application Publication no. 2002/0110992 by Ho. Applicant respectfully traverses at least for the reasons discussed hereinafter.

Initially considering the limitations of claim 1, as amended, a system is recited:

[F]or use in removing an implant crust that is formed as an outermost layer of a photoresist pattern that is supported by a treatment object, said implant crust being formed responsive to exposure of the treatment object to a high dose ion implant which introduces an implanted dopant into the treatment object as well as into the photoresist, thereby producing said implant crust, said system comprising:

a treatment chamber within which a plasma is generated using a hydrocarbon gas in combination with oxygen gas in a way which subjects the implant crust to the plasma for use in removal of the implant crust, said plasma being free of halogens, at least to an approximation.

It is noted that claim 1 has been amended to incorporate the limitations of original claim 5, now canceled, and with the full support of the specification in order to point out the characteristics of an implant crust. In this regard, it is noted that claim 5 was not rejected under § 102 over the Ho reference. Such an implant crust is described, for example, in paragraph 39 of Applicants' specification. The crust is formed in a known manner during an ion implantation process in which a substrate supports a patterned layer of photoresist, as is illustrated by Applicants' Figures 3 and 4. During ion implantation, dopant species are driven into exposed regions of the substrate for use in forming specific portions of an overall active device structure. The dopant atoms can form, as an example, junctions in this active device structure. During the ion implantation, the photoresist protects underlying regions of the substrate from implantation by the dopant species. In so protecting the underlying substrate, however, the photoresist is itself implanted with the dopant species. Paragraph 40 of Applicants' specification describes at least three different ways in which the ion implantation is thought to alter the photoresist, with reference to Figure 4. With the foregoing in mind, it should be appreciated that the implant crust is a somewhat unusual material and the prior art has attempted a number of approaches in attempting to remove the crust, while preserving the underlying substrate, as discussed in Applicants' specification, while meeting only limited success.

Further, ion implantation should not be confused with an etching process such as, for example, reactive ion etching (RIE) in which a substrate and supported photoresist layer can be bombarded by a plasma that is intended to remove materials from the structure such as the photoresist. RIE does not form an implant crust, as does ion implantation of a dopant

species. In this regard, an RIE process is applied for the purpose of removing materials from the target structure such as, for example, the photoresist, whereas ion implantation of a dopant species is intended to add material to the device structure and, in the process, also adds the dopant species to the photoresist.

With regard to Ho, the Examiner states that Ho teaches a system for use in removing a process material crust (dielectric layer 318 in Fig. 3A) from a treatment object. Applicants respectfully disagree, particularly in view of amended claim 1. What Figures 3A-3C of Ho illustrate is merely an etching process that is performed through a patterned layer of photoresist. Dielectric 318 is part of the device structure, it is not an implant crust within the meaning of amended claim 1. In this regard, Applicants find no mention of an implant crust in Ho. In supporting the rejection, the Examiner refers to paragraph 41 of Ho. This paragraph, however, at lines 1-3, states that photoresist was removed in a previous step. Ho is not directed to removal of photoresist, but rather to eliminating or mitigating the formation of a micromask which results from sputtering of a hardmask layer 318, that is progressively exposed beneath photoresist 310 as the etching of dielectric 318 proceeds. The asserted benefits of Ho's technique are described in paragraph 70 of the published application. It should be appreciated that Ho is not directed to a process for removing photoresist, nor an implant crust. Accordingly, Ho fails to teach, disclose or reasonably suggest the combined limitations of claim 1, as amended. For at least the reasons set forth above, allowance of claim 1 is respectfully requested. However, there is an additional, compelling reason which favors the patentability of claim 1 over Ho, as will be discussed immediately hereafter.

Claim 1 requires that the plasma is free of halogens, at least to an approximation. In attempting to meet this limitation, the Examiner refers to paragraph 73 of Ho. This paragraph merely states that fluorine is not used, it says nothing about halogens in general. Further, it merely says that fluorine is not used, it does not say that fluorine cannot or should not be used. In order to make out a proper rejection under § 102, it is well-settled that a reference must identically disclose the limitation on which it is relied on as teaching. In this case, it is respectfully submitted that the statement in paragraph 73 of Ho, with respect to fluorine, falls well short of this standard with respect to the limitations of claim 1. Accordingly, for this reason standing on its own, allowance of claim 1 is respectfully requested over Ho.

Claims 2-4, 9-11 and 15, as amended, each depend either directly or indirectly from and therefore include the limitations of claim 1. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 1, further distinguish the claimed invention from the art of record.

With respect to claims 2-4, the Examiner again refers to paragraph 41 of Ho. As discussed above, however, there is no photoresist present on Ho's wafer. Accordingly, there is likewise no implant crust for removal. Further, the Examiner appears to refer to paragraph 28 of Applicant's own specification as somehow supporting the rejection. It is noted that paragraph 28 appears in the Detailed Description. Therefore, Applicants respectfully consider the reference to this paragraph to be improper. In this regard, Applicants find no mention of molecular weight, as recited by claim 3, or CH_2 and CH_3 radicals, as recited by claim 4, in paragraph 41 of Ho. For at least these reasons, allowance of claims 2-4 is respectfully requested.

Claim 20 is an independent claim which includes the limitations of claim 1, as discussed above, but in method form. Further, claim 20 has been amended to include the limitations of claim 24, now canceled, and with the full support of the specification. In this regard, it is noted that claim 24 was not rejected under § 102 over the Ho reference. Accordingly, the arguments made above in behalf of the patentability of amended claim 1 over the art of record are considered to be equally applicable with respect to the patentability of amended claim 20. Therefore, claim 20, as amended, is considered to be allowable for at least these reasons.

Claims 21-23, 28-30, 32, 33, as amended, each depend either directly or indirectly from and therefore include the limitations of claim 20. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 20. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 20, further distinguish the claimed invention from the art of record.

With respect to claims 21-23, the Examiner again refers to paragraph 41 of Ho. As discussed above, however, there is no photoresist present on Ho's wafer. Accordingly, there is likewise no implant crust for removal. Further, the Examiner appears to refer to paragraph 28 of Applicant's specification as somehow supporting the rejection. It is noted that paragraph 28 appears in the Detailed Description. Therefore, Applicants respectfully consider the reference to this paragraph to be improper. For at least these reasons, allowance of claims 21-23 is respectfully requested.

Claim 67 is an independent claim which has been amended, like claim 1, to point out that an implant crust, which is formed from photoresist, responsive to a high dose ion implant, is being removed. Further, claim 67 further recites that a halogen free plasma is generated in a plasma chamber using a gas in combination with oxygen gas in a way which produces at least one of CH_2 radicals and CH_3 radicals in the plasma and which subjects the implant crust to the plasma for use in removal of the implant crust. Accordingly, the arguments made above, in favor of the patentability of claim 1 over Ho, are equally applicable with respect to the patentability of amended claim 67, at least for the reason that Ho fails to teach, disclose or reasonably suggest the removal of an implant crust that is formed from a high dose ion implant. The Examiner again appears to refer to paragraph 28 of Applicant's specification as somehow supporting the rejection. It is again noted that paragraph 28 appears in the Detailed Description. Therefore, Applicants respectfully consider the reference to this paragraph to be improper. For at least these reasons, allowance of claim 67, as amended, is respectfully requested.

Claim 68, as amended, reflects the limitations of claim 67, but in method form. Accordingly, it is considered that the arguments made above, in favor of the patentability of claim 67 over Ho, are equally applicable with respect to the patentability of claim 68. For at least these reasons, allowance of claim 68 is respectfully requested.

The Examiner rejected claims 1-9, 15, 16, 20-28, 67, 68, 75 and 76 under 35 USC 102(b) as being anticipated by U.S. Patent no. 5,770,100 issued to Fukuyama et al (hereinafter the '100 patent). Applicant respectfully traverses at least for the reasons discussed hereinafter.

In making out the rejection, the Examiner refers to col. 5, lines 30-64, of the '100 patent, asserting the removal of a process material crust. Applicant respectfully disagrees and submits that there is no reasonable teaching in this passage with respect to the removal of an implant crust, as recited by amended claim 1. What this passage is describing is a corrosion

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prevention technique which ashes photoresist that is used for forming a wiring pattern as is described at col. 5, line 65, carrying over to col. 6, line 2 of the '100 patent. No photoresist implant crust is present, since high dose ion implantation is used for purposes of forming elements of an active device structure, not in the formation of a wiring pattern. The latter merely requires etching away portions of an overall metal layer that are exposed by a photoresist pattern.

Further, with respect to original claim 5, now canceled, but which limitations are now encompassed by amended claim 1, the Examiner refers to col. 1, lns. 61-65 of the '100 patent which states:

On the thus etched wiring pattern, remains a photoresist (hereinafter referred to as "resist") which is a masking material. Halogen components in the plasma adhere on the surface of the resist during the etching and halogen components are implanted due to the bombardment of ions.

It should be appreciated that the halogen components that are of concern in the passage that is set forth immediately above, do not form a photoresist implant crust. The formation of the latter requires bombardment of photoresist with dopant atoms, as described above. Accordingly, it is respectfully submitted that the '100 patent bears no reasonable relationship to the limitations at hand. For at least these reasons, allowance of claim 1 over the '100 patent is respectfully requested.

Claims 1-4, 6-9, 15 and 16, as amended, each depend either directly or indirectly from and therefore include the limitations of claim 1. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 1, further distinguish the claimed invention from the art of record.

With respect to claims 2-4, the Examiner again refers to col. 5 of the '100 patent. As discussed above, however, there is no photoresist implant crust present. Accordingly, there is no implant crust for removal. Further, the Examiner appears to refer to paragraph 28 of Applicant's specification as somehow supporting the rejection. It is noted that paragraph 28 appears in the Detailed Description. Therefore, Applicants respectfully consider the reference to this paragraph to be improper. In this regard, Applicants find no mention of molecular weight, as recited by claim 3, or CH_2 and CH_3 radicals, as recited by claim 4, in col. 5 of the '100 patent. For at least these reasons, allowance of claims 2-4 over the '100 patent is respectfully requested.

Claim 20 is an independent claim which includes the limitations of claim 1, as discussed above, but in method form. Further, claim 20 has been amended to include the limitations of claim 24, now canceled, and with the full support of the specification. Accordingly, the arguments made above in behalf of the patentability of amended claim 1 over the art of record are considered to be equally applicable with respect to the patentability of amended claim 20. Therefore, allowance of claim 20, as amended, is respectfully requested for at least these reasons.

With respect to claims 21-23 the Examiner again refers to col. 5 of the '100 patent. As discussed above, however, there is no photoresist implant crust present. Accordingly, there is no implant crust for removal. Further, the Examiner appears to refer to paragraph 28 of Applicant's specification as somehow supporting the rejection. It is noted that paragraph 28 appears in the Detailed Description. Therefore, Applicants respectfully consider the reference to this paragraph to be improper. In this regard, Applicants find no mention of molecular weight, as recited by claim 22, or CH_2 and CH_3 radicals, as

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recited by claim 23, in col. 5 of the '100 patent. For at least these reasons, allowance of claims 21-23 over the '100 patent is respectfully requested.

Claim 67 is an independent claim which has been amended, like claim 1, to point out that an implant crust, which is formed from photoresist responsive to a high dose ion implant, is being removed. Claim 67 further recites that a halogen free plasma is generated in a plasma chamber using a gas in combination with oxygen gas in a way which produces at least one of CH_2 radicals and CH_3 radicals in the plasma and which subjects the implant crust to the plasma for use in removal of the implant crust. Accordingly, the arguments made above, in favor of the patentability of claim 1 over the '100 patent, are equally applicable with respect to the patentability of amended claim 67, at least for the reason that the '100 patent fails to teach, disclose or reasonably suggest the removal of an implant crust that is formed from a high dose ion implant. Further, Applicants find no mention of CH_2 radicals and CH_3 radicals in col. 5 of the '100 patent. The Examiner again appears to refer to paragraph 28 of Applicant's specification as somehow supporting the rejection. It is again noted that paragraph 28 appears in the Detailed Description. Therefore, Applicants respectfully consider the reference to this paragraph to be improper. For at least these reasons, allowance of amended claim 67, as amended, is respectfully requested.

Claim 68, as amended, reflects the limitations of claim 67, but in method form. Accordingly, it is considered that the arguments made above, in favor of the patentability of claim 67 over the '100 patent, are equally applicable with respect to the patentability of claim 67. For at least these reasons, allowance of amended claim 68 is respectfully requested.

Claim 75 is an independent claim which has been amended to point out that the residue that is being removed is produced by a high dose ion implant and that an implant dopant species is part of the residue that is being removed. While col. 5 of the '100 patent discusses "residual adhered matter", col. 5, lns. 26-29 of this column describe the content of the residual adhered matter as that which is produced from a wiring pattern etch. In view of the discussions above, there are no implanted ion species, from a high dose ion implant, present in either the treatment object or the photoresist, which would generate a residue that contains such an implant species. Accordingly, for at least these reasons, allowance of amended claim 75 over the '100 patent is respectfully requested.

Claim 76 is an independent claim which has been amended to reflect the limitations of amended claim 75, but in method form. The arguments made above in favor of the patentability of claim 75, over the art of record, are therefore considered to be equally applicable with respect to the patentability of claim 76. Accordingly, for at least these reasons, allowance of claim 76 over the '100 patent is respectfully requested.

The Examiner rejected claims 1, 17, 19, 20, 34 and 36 under 35 USC 102(b) as being anticipated by U.S. Patent no. 5,763,328 issued to Yoshihara et al (hereinafter the '328 patent). Applicant respectfully traverses at least for the reasons discussed hereinafter.

Applicants initially note that the '328 patent is similar in spirit to the '100 patent. That is, the '328 patent deals with ashing and corrosion issues, subsequent to etching of an aluminum wiring layer.

In making out the rejection of claim 1, the Examiner refers to col. 1, lns. 51-60 and col. 2, lns. 28-42 of the '328 patent. In view of the amendments of claim 1, discussed above, Applicants see no reasonable teaching, suggestion or

disclosure in these passages of the presence of an implant photoresist crust, since the process that is being described merely follows a wiring etch that clearly does not require the use of a high dose ion implantation. Accordingly, for at least these reasons, allowance of claim 1, as amended, over the '328 patent is respectfully requested.

Claims 17 and 19 each depend directly from and therefore include the limitations of claim 1. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 1, further distinguish the claimed invention from the art of record.

Claim 20, as amended, is an independent claim which includes the limitations of amended claim 1, as discussed above, but in method form. Accordingly, the arguments made above in behalf of the patentability of amended claim 1 over the art of record are considered to be equally applicable with respect to the patentability of amended claim 20. Therefore, claim 20, as amended, is considered to be allowable over the '328 patent for at least these reasons.

Claims 34 and 36 each depend directly from and therefore include the limitations of claim 20. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 20. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 20, further distinguish the claimed invention from the art of record.

The § 103 Rejections

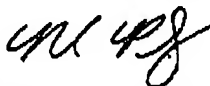
The Examiner rejected claims 18 and 35 under 35 USC § 103(a) as being unpatentable over the '328 patent. Applicants respectfully traverse. Claim 18 depends directly from amended claim 1, while claim 35 depends directly from amended claim 20. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to amended claims 1 and 20, respectively. Further, each of these dependent claims places additional limitations on its parent claim which, when considered in light of amended claims 1 and 20, further distinguish the claimed invention from the art of record.

The Examiner rejected claims 13 and 14 under 35 USC § 103(a) as being unpatentable over Ho in view of a book by Wolf et al., entitled "Silicon Processing for the VLSI Era". Applicants respectfully traverse. Claims 13 and 14 each depend directly from and therefore include the limitations of claim 1. Initially, Applicants note that the Wolf reference appears to contribute nothing to the basis of the § 102 rejections of claim 1, as discussed above, when viewed in any reasonable light and in any reasonable combination with the remaining art of record. Accordingly, it is respectfully submitted that each of these claims is also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Further, each of these dependent claims places additional limitations on their parent and intermediate claims which, when considered in light of claim 1, further distinguish the claimed invention from the art of record.

New claims 81 and 82 have been presented for consideration by the Examiner, and are believed to be directed to patentable subject matter. For example, Applicants are unable to find any reasonable teaching, suggestion or disclosure in the art of record with respect to the use of a 50% methane and 50% oxygen form an overall gas mixture.

If the Examiner has any questions concerning this case, the Examiner is respectfully requested to contact Mike Pritzkau at 303-410-9254.

Respectfully submitted,



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